Center for Neutron Science

Description: The principal goals of the Center for Neutron Science (CNS) are: i) to promote neutron science at Brookhaven, ii) to develop new instrumentation for BNL scientists and the national user community, and iii) to develop and nurture the growing user community. In order to accomplish these goals, the CNS will take the lead in developing new instrumentation including relocation of the US-Japan spectrometer to the HFIR at Oak Ridge and proposing a new instrument (HYSPEC) to be constructed at the SNS. The CNS will coordinate a BNL-NIST Alliance where a BNL paid scientist will be stationed at NIST and serve as a contact person for BNL scientists and their collaborators. Also, the CNS will oversee the use of the AGS as a test station for research into high-power spallation source targets, shielding tests and neutron detector development and testing. The CNS will pursue the need for a new steady state neutron source.

Program Highlights:

- Successfully arranged for transfer of HFBR instruments to HFIR, NIST, U. of Rhode Island, U. of Michigan, Los Alamos, Australia (pending), S. Korea (pending) and equipment to MIT, NIST,SNS
- Developed a cost estimate for relocation of US-Japan instrument to HFIR at ORNL
- Developing HYSPEC, a direct geometry hybrid inelastic spectrometer for single crystal inelastic studies at the SNS. Workshop held at BNL Oct. 12 –13. A Letter of Intent is being prepared.
- AGS Spallation Target Experiment (ASTE) successfully tested Hg targets for the SNS and carried out shielding studies in collaboration with the European Spallation Source (ESS) and the Japanese Joint Project.
- Developed concept for post-SNS accelerator based continuous neutron source.

Impact:
The efforts of the Center of Neutron Science have kept neutron science at the forefront at BNL

Interactions:
US National Laboratories: NIST, ORNL, Ames Lab., SNS
US Universities: Iowa State,
International Laboratories and Universities: U. of Tokyo-ISSP, U. of Tohoku, JAERI, CEN-Grenoble, ESS, PSI-Switzerland, LLB-France, HMI-Germany

Personnel: S. M. Shapiro (1/2) (Center Director) J. B. Hastings (until 10/1/01), B. Winn (Post Doc), V. Ghosh (Consultant), L. Passell (Consultant)

Budget: $713K (FY02)

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Scientific Staff:

Stephen M. Shapiro (5/1/01)	Martensitic transformations, spin glasses, f-electron systems
J. B. Hastings (Departed 10/1/01)	Target testing at AGS, ASTE Collaboration
Barry Winn	H4M relocation, Monte Carlo, Martensitic transformations
Larry Passell (Consultant)	SNS instrument development
Vinita Ghosh (Consultant)	Monte Carlo Studies

Support Staff:

1/4 Secretary

Facilities:

Use of other national facilities:
- NIST
- ORNL

Use of other international facilities:
- JRR3M (Japan)
- LLB (France)
- ILL (France) Agreement with AEC laboratory at Grenoble
- ISIS (England)
- PSI (Switzerland)
- HMI (Germany)
- FRMII (Germany) Pending start up of reactor

AGS for target and shielding testing

Future Directions:

Relocate and operate US-Japan 3-axis instrument at HFIR (Oak Ridge)
Prepare proposal for HYSPEC to be built at SNS
Develop concept for a post-SNS continuous neutron source.

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Major Outside Collaborators

Thomas Lograsso	Ames Lab
D. L. Schlagel	Ames Lab
Stephen Nagler	Oak Ridge
Herb Mook	Oak Ridge
Hideki Yoshizawa	ISSP-Tokyo
Luke Daemon	Los Alamos
Phil Seeger	Los Alamos
R. Erwin	NIST
G. Bauer	PSI
N.Watanabe	JAERI

BNL Collaborators

J. Larese	BNL-Chemistry (until 10/1/01)
Y. Zhu	BNL-Materials Science
H. Ludewig	BNL-EST
M. Todosow	BNL-EST
P. Montanez	BNL-NSLS
A. Ruggiero	BNL-CAD
P. Pile	BNL-CAD
A. Pendzick	BNL-CAD

ASTE Collaboration	Germany, Japan, Switzerland, USA

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Highlights

Instrumentation:

Relocation of instruments from HFBR

All instruments on the experimental floor have been disassembled and removed from the HFBR building. Many have been relocated as follows: H4M 3-axis to ORNL; H7 3-axis to NIST for use on beam line BT9; H9A 3-axis to University of Rhode Island; H4S 3-axis to Los Alamos; H5 powder diffractometer and H9A reflectometer to Korea (pending); H1A high resolution powder diffractometer to Australia (pending). Other equipment has also been sent to facilities where collaborative research will take place.

Relocation of US-Japan spectrometer to HFIR

With the shutdown of the HFBR, DOE has an obligation under the implementation agreement between the US and Japan to relocate the US-Japan H4M spectrometer to the HFIR. It was agreed to place this instrument in the new guide hall on the CG4 guide. This is a curved guide and should provide a very high neutron flux. A detailed cost estimate was prepared ($3.2M) and submitted to DOE. The major item is constructing and installing a new monochromator shield to match the secondary spectrometer that was previously located at the HFBR.

Development of Hybrid Spectrometer (HYSPEC) for the SNS Project

The Center for Neutron Science and the Neutron Scattering Group have spearheaded the conceptual design of a novel instrument to be proposed for the Spallation Neutron Source. Monte Carlo studies have demonstrated that by combining a focussing monochromator with a series of choppers, forming a hybrid spectrometer, it will outperform other instruments proposed for the SNS for single crystal studies on small samples. A team has been assembled and a workshop was held in early October to prepare a letter of intent that will be submitted to the Experimental Facilities Advisory Committee (EFAC) by the end of the year. If accepted by EFAC, a complete proposal will be submitted.

AGS Spallation Target Experiment (ASTE)

The CNS partially funded a joint project with the SNS, the European Synchrotron Source (ESS) and the Japanese Spallation Source Project to study the behavior of a mercury target after bombardment with an intense proton beam. The AGS can reliably deliver proton pulses up to 240 kjoules, which is much larger than planned for the next generation spallation neutron sources. For example, the beam power at the Japanese source is expected to be 40 kjoules. The AGS based experiments demonstrate that the neutronic code system for neutron flux calculations is reliable and the codes are adequate for designs of spallation neutron sources. In addition, studies on various types of shielding were carried out and compared to the calculations.

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Conceptual Design Studies of a Neutron Source at BNL

Studies have been carried out on developing an accelerated driven continuous neutron source that could be constructed at BNL. The source would use a superconducting linac driver, operating in the continuous mode, and accelerating protons to 1GeV with an average beam power of 10 MW. The protons would strike a solid tungsten target and produce a steady state flux of 10^{15} neutrons/ cm^2/sec, equivalent to the highest fluxes available at reactors. The calculations show that this is feasible and could provide a neutron source to replace the HFBR.

Scientific:

Anomalous phonon damping in high temperature shape memory alloy: $Ti_{50}Pd_{42}Cr_8$

Shape memory materials have a wide range of applications, but most of them have been restricted to near ambient temperatures. TiPd alloys have transformation temperatures near 800K, which is the temperature range where application in engines becomes possible. The first inelastic neutron studies were performed on the alloy $Ti_{50}Pd_{42}Cr_8$, whose transformation temperature is near 400K, which is experimentally more accessible. The phonons propagating along the [110] transverse direction are highly overdamped throughout the Brillouin zone. In contrast to most other systems studied, there is no particular q-value where the phonon energy or linewdith correlates with the observed elastic diffuse scattering (B. Winn, S. M. Shapiro, D. Schlagel (Ames Lab), T. Lograsso (Ames Lab))

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Publications

Futakawa, M., Kikuchi, K., Conrad, H. and Stechemesser, H. and ASTE collaboration, J. Nuc. Inst. Meth. A 439, 1 (2000).

Meigo, S. et al. (ASTE collaboration), Measurement of spectrum for thermal neutrons produced from H_2O moderator coupled with mercury target, Proc. 15th Meeting of the International Collaboration on Advanced Neutron Sources (ICANS-XV), Tsukuba, Nov. 6-9 (2002) JAERI-Conf, 2001-002, 2001, p 941.

Kasugai, Y, et al. (ASTE collaboration), Measurement of induced radioactivity in a spallation neutron field of a mercury target for GeV proton bombardment, *ibid*, p 955.

Maikawa, F. et al., (ASTE Collaboration), Analysis of the AGS experiment on a mercury target with a moderator and a lead reflector bombarded by GeV energy protons, *ibid*, p. 983.

Ludewig, H., Hastings, J., Montanez, P., Todosow, M., Conceptual design studies of a neutrons source at the BNL-HFBR facility, *ibid*, p.1037

Winn, B. L., Shapiro, S. M., Erwin, R., Schlagel, D. L., Lograsso, T. Anomalous phonon damping in the high temperatue shape memory alloy $Ti_{50}Pd_{42}Cr_8$. Proceedings of ICNS-01 (To be published in Applied Physics A)